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COMPLEMENTARY SUSTAINABLE LEARNING ENVIRONMENT
FOR ELEMENTARY SCHOOL

Sandra Wolf Lange

Thesis submitted in partial fulfillment of the requirements for the degree
of Master of Design in Industrial Design, University of Alberta
September, 2002

"Let the heavens be glad, the earth rejoice;
let the vastness of the roaring seas demonstrate his glory.
Praise him for the growing fields, for they display his greatness.
Let the trees of the forest rustle with praise."

Psalms 96:11,12



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Abstract

The present work addresses the design of an alternative learning environment for elementary school students. The principles of sustainable design are applied to the development of this new learning environment for two reasons: to reduce the environmental impact of a school addition, and to serve as a model and a means of teaching sustainability to the younger generation. The new learning environment will consist of the combination of an open eco-garden and a winter garden attached to a classroom. Design aspects that qualify the project as sustainable and environmentally friendly will be discussed, along with the educational impact that such a project can have in children's awareness, education, and consequently in the future of our society.



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Introduction

The ongoing energy crisis and the looming problem of water shortage, as well as the threat of global warming, remind us that our resources are limited and that our ecosystem can take only so much damage. However, these concerns tend to be short-lived in our society. As soon as the situation is relieved by a reduction of the prices, or by some form of government rebate, people's attention turns to something else, as if the problem was solved. The truth is that the problem is much more serious than the momentary burden of the extra cost to the economy. The only long-term answer to these problems is a new way of living, manufacturing, and building that respects the limitations of our environment. In other words, our life-style and our products must be designed to be sustainable, without depleting our limited resources.

Unfortunately, sustainable design is still not widely understood in our communities, though there is a small group that supports it. This group is mainly made up by environmentalists, intellectuals, and higher income earners. The issues that prevent most people from having a positive attitude towards sustainability seem to be mainly related to cultural, aesthetic, and misconceived economic factors. Many of these issues are not easily overcome, because they are deeply rooted in the beliefs of the adult population.

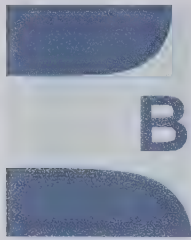
While adults have stereotypes, tastes and preferences entrenched by a consumerist culture, children are more likely to accept new ideas without bias. By teaching them the concepts and practical aspects of sustainable living it is possible to counter the influence of society's consumerist pressure on them, and to prevent prejudice against sustainable design from being formed in the first place. In addition, there are many other proven benefits to children's education from the nature-based learning

environment proposed in this work, such as behavioural and cognitive improvements, and increased civic consciousness.

This project addresses the design of a learning environment for children, applying the general principles of sustainable design, taking into account the climatic, geographic, cultural and economic issues particular to the Edmonton region. The implementation of this model of learning will be applied to the case of Elmwood Elementary School. This will be accomplished by means of a combination of an open eco-garden and a winter garden attached to a classroom, which will serve primarily as the science room. The design concept will be flexible, in order to accommodate many other potential functions outlined in this thesis.

Sustainable design in its strictest sense means a design that does not deplete any natural resources from the manufacturing of a product, through its use, up to its disposal. This theoretical goal is in practice very difficult to attain and to demonstrate. So, in this text I refer to sustainable design in a broader sense, meaning a design that makes concrete and practical steps towards less depletion and more sustainability.

This work has profited from the fact that the city of Edmonton, where the work was developed, is becoming a major centre for the study and implementation of sustainable development. What is more, the present work acquired a new, more relevant dimension, when Elmwood Elementary School, an Edmonton school with a stellar record in environmental education, became interested in the project. This combination of the city and the school provide the perfect setting for the application of the present design concept.



Background

Sustainability

For several decades there has been a growing concern about the need to restructure our society in a sustainable way in order not to irreversibly deplete the limited resources available on our planet, and to allow us to live in harmony with nature.

At the UN Conference on Human Environment in Stockholm, 1972, the international community met for the first time to consider the issue of global environment and sustainability. Twenty years later, another UN conference, the *Earth Summit* in Rio de Janeiro, produced a Declaration and an Agenda outlining key policies for achieving sustainable development that recognises the limits of development to meet the global needs. Although many of the goals set at the Rio Earth Summit remain unachieved, the nations met again this year in Johannesburg at the World Summit for Sustainable Development for an assessment of the progress made. As a result of the Summit, governments agreed on a series of concrete commitments, summarized in a Plan of Implementation, containing targets and timetables to spur action on a wide range of issues. In addition, many countries have already signed the Kyoto Protocol for control of greenhouse gas emissions, although the largest emitter, the US, refuses steadfastly to join, which initially caused Canada to hesitate also.

Numerous initiatives introducing, or promoting sustainability are appearing at a local, regional, or national level in several countries. Even some corporations are beginning to embrace the idea, as witnessed by the many examples described by David Suzuki and Holly Dressel in *Good News for a Change*. These initiatives are by no means restricted to

highly developed countries. For instance, the Ethos Institute of Business and Social Responsibility, created 1998 in Brazil, is an association of Brazilian companies, large and small, that are interested in adding ethical and socially responsible behaviour to their basic competencies. In their road map for sustainability, *Natural Capitalism*, Paul Hawken and Amory and Hunter Lovins also cite many examples of early adopters and promoters of sustainable development. However, the authors of the cited books acknowledge that the examples are still isolated, corresponding rather to courageous pioneers, than to representatives of an irreversible trend.

The values and ideals of sustainability are not spreading easily through society. On the contrary, they often hit barriers that seem insurmountable. A significant obstacle is what Rees (1994) calls "our collective perception of reality" or "our culturally shared illusions [that] stand in the way of sustainable development." One of these illusions, deeply rooted in our economic view of the world, is that the biosphere is a mere source to be plundered in satisfaction of the material needs and wants of our society. Especially in present Western societies the capitalist system has propagated values and beliefs that correspond to a worldview, which considers natural and human resources as being abundant and having little value compared to the final product. In case of shortages, according to this belief, new substitutes will be developed. In summary, "enough money can buy enough resources" (Hawken et al., p. 7). The same distorted idea is commonly applied to waste. As long as it is out of the way, no matter how, it is not a problem anymore.

In addition, modern society has become accustomed to the idea that continuous material growth is not only possible, but also a highly coveted sign of success. There is a pattern of ever increasing consumption and ostentation, as if our society were addicted to it. As Al Gore suggests in an essay (1994), because of the culturally conditioned separation between man and nature, "our civilisation is, in effect, addicted to the consumption of the earth itself."

These old values are deeply entrenched in our society. The adult population especially has been exposed to them for years through the traditional education system, through the media and marketing, all being reinforced by peers, who define what is "in" and what is "cool". To Al Gore (1994), who compares our civilisation to a dysfunctional family, these distorted values and illusions that prevent us from being more ecologically responsible are like unwritten rules passed on from generation to generation, which are not supposed to be questioned.

Because they are so pervasive, these old values become traditional, and as such they are very hard to challenge. Some advocates of sustainability naively think that traditional attitudes can be changed by simply showing the potential economical benefits or cost reductions that a sustainable approach can bring. This was, for instance, the approach chosen by Richard Montgomery (1982) in his guide about solar energy use in homes, which is full of cost charts and comparisons. If this were true, people wouldn't be spending thousands of dollars more to purchase and drive sport utility vehicles (SUVs), instead of cheaper, more energy efficient cars. Or spend tremendous amounts of water, pesticides, and time to keep a lawn of non-native variety artificially "pure". Their decision making is obviously not just driven by cost and economics.

There seems to be a perception in society that we have to control all aspects of our environment, that everything that is *artificial is good*. By artificial I mean what is imposed and maintained only through human intervention, not naturally. Since the advent of the industrial era with its technology and abundance of cheap non-renewable energy sources, society has had the means to completely divorce the interior environment of buildings from the exterior. This was perceived as freedom from nature's processes and moods. Along the same lines, building materials became uncoupled from their geographic and climatic surroundings. "The cost of turning architecture and landscape into matters of industrial production and fashion has been high in terms of energy and materials consumption and ecological dysfunction." (Lyle, 1994)

We are living, working, studying apart from nature. We do everything possible, from the use of poisons to sealed buildings, to keep nature away from us, from being a part of our environment. People blame weeds and pollen for the growing tide of allergies and asthma, but they forget that pesticides, sick buildings, and car emissions are the new elements overloading our immune systems. We tend to remove what is natural, exposed soil, weeds, and insects, and replace them enthusiastically with artificial things, such as concrete, asphalt, or "pure" lawn, full of pesticides and kept so short as to look more like a carpet than a natural grass. The ultimate irony is that, after spending many resources performing this substitution of natural by artificial things, we miss nature and try to reintroduce it through "nature mock-up landscaping", and even electronically produced nature sounds!

A symbol of this "artificial is good" mentality are the dandelions. Considered as a weed, a pest by most lawn-lovers, advertised as evil by pesticide manufacturers, this beautiful yellow blooming species has many nutritional and medicinal properties. If lawn-lovers would embrace and enjoy the dandelions, instead of fighting them, they would reduce enormously the cost and stress of keeping their garden, and they would see life coming back to it after all poison is washed away.

We need to reconcile with nature, to regain the sense of beauty of the natural, non-groomed setting. We need to learn again how to live with nature. The impulse to control nature, eliminating pests and predators, may seem to many as just a matter of "cleaning" the environment in our vicinity. But when you remove completely a whole section from a natural environment, be it weeds, insects, frogs, groundhogs, or crows, the ecosystem becomes unbalanced and unhealthy. A healthy landscape is full of life and diversity, full of complexity and interesting surprises. We need to restore the notion that this diversity is not only beautiful and desirable, but in fact necessary. Then people would be able to see the real value of our natural resources, not just the non-renewable minerals, but the whole biodiversity. The same principle applies to buildings, if we want to be consistent in our sustainable approach. As Lyle (1994) puts it, going to the realm of design, "we find the form of the human habitat to be

shaped less by the dictates of fashion and stylistic dogma and more by the processes of nature. Buildings become again part of the earth."

How to Break Through

The truth is that the frequent high-level environmental conferences and symposia, demonstrations and campaigns are mostly preaching to the converted, because they are not able to challenge the deeply rooted misconceptions and stereotypes that prevent sustainability and living with nature from becoming main stream in our society. The best way to challenge the old, non-sustainable and artificial values is to work at the root of the problem, namely at the earliest levels of education, before wrong values become entrenched.

Hawken and co-authors (p. 6) remind us of Einstein's dictum that problems can't be solved within the mindset that created them. If we want to form the agents that will genuinely solve the problems of resource depletion facing our society, we need to educate them into a new mindset. Hawken also reminds us that our schools are not only the largest institution addressing the mental models that drive society, but also that "schools can change their impact in the environment in two fundamental ways." (ibid., p. 315) The first comprises the traditional knowledge transfer through instruction about environmental systems and their preservation. Secondly, they ascribe to Prof. David Orr the realisation that the way schools are built, and how they purchase energy, materials, food, and water amounts to a "hidden curriculum" that is as powerful as any overt curriculum to teach sustainable values to the future citizens of our society. Teaching by example can be even more powerful than any classroom lesson, and this idea constitutes one of the pillars of the present work.

For Herbert Leff (p. 307) "education offers the most promising path to effecting long-term pro-life [towards a healthier environment] changes in our consciousness and in our society". He summarises several points

that environmental education should observe to successfully raise ecological consciousness:

Environmental education should not only aim at increasing environmental knowledge and awareness, but also ecological systems thinking and a sustainable value system.

To effectively accomplish those aims, the process should include training for problem solving, using active inquiry methods, emphasising interdisciplinarity, incorporating values clarification, encouraging student participation in the process, and making use of the whole community by helping students relate to actual local environmental issues and take action upon them.

We do not need to dwell on environmental *dangers* in order to stimulate environmental concern or a sense of interrelatedness, but *hope* for surroundings to which we can relate more joyously is actually preferable.

There should also be emphasis on social, as well as purely environmental concerns, because of the interrelatedness of environmental and social problems, which require collaborative action to improve the whole community.

Leff sees that even small environmental successes obtained from such educational approach would serve to inspire the world outside the school, and also help the participants gain an enhanced sense of competence and responsibility. This makes environmental education a potent force for encouraging ecological and sustainable consciousness, precisely because environmental problems are so deeply intertwined with our cultural values. While these values are stereotypically engraved in an adult mind, children are less biased and more open to accept new values.

I had the opportunity to get a first hand account of the level of receptivity children show to new and challenging ideas. In field research at a Toys "R" Us store I interviewed 3 salespersons (two female and one male) separately about children preferences for toys. To my surprise all three reported that most children, boys and girls alike, show preference for toys and gadgets that are more technically challenging, more "complicated", and those with many small parts. Microscopes and telescopes are favourites, but also science kits, assembling toys, such as Lego, or purses full of little things. However, sales numbers might not be reflecting this preference at all, because parents apparently tend to buy bigger, simpler toys than those their children prefer, at least according to this small preliminary survey. Parents may be partially motivated by cost and safety issues, but the salespersons also observed a preconceived idea of what children "should like" playing a role in the purchasing decisions of parents. This anecdotal evidence shows that children seem to be more inclined to investigate and like what is perceived as "complicated" and "awkward", than statistics or parental impressions may suggest. This supports the approach of the present project that aims at introducing children to the intricate relationships of ecosystems and to the mostly unfamiliar forms of sustainable buildings and energy sources.

The idea of teaching children the values one wants to transfer to society is not new. In fact, this wisdom is as old as the book of Proverbs in the Bible, where Solomon advises to "train a child in the way he should go, and when he is old he will not turn from it." (Proverbs 22.6)

In the present day, there is also plenty of recognition that environmental issues should be part of education. Martha Monroe edited a collection of case studies presented in 1996 at an international workshop of the North American Association for Environmental Education (*What Works*). These are nearly fifty success stories from around the world, which ranged from documentary television specials to handmade posters, from small community projects to national education reform campaigns. One of the case studies, presented by Lou Ann Dietz and Vera Rodrigues, from World Wildlife Fund (WWF)- US and WWF-Brazil, respectively, (p. 38, 39) describes the effort to institutionalise environmental education

nationally in Brazil, following a mandate from the 1988 Brazilian Constitution. The project focused on teacher training and curriculum development for grades 1-4, and involved partners representing different geographic regions, educational content, and institutions. This effort resulted in a guidebook "to help teachers understand environmental education and to stimulate teachers to integrate teaching about the environment into all disciplines."

Most of the efforts towards environmental education in schools aim simply at bringing environmental issues into the curriculum. There are, however, a few notable examples that have gone beyond that.

For example, I had the opportunity to observe at length a Grade 1 class in Edmonton as part of my field research, which will be described in detail later. During that period I observed closely the interaction between children and nature, as they were learning through a hands-on gardening project. They showed a keen interest in it, especially in living things, such as insects, buds, and flowers, but also in the natural soil. Their interest and curiosity translated into excitement that led them naturally to "research", that is, to want to learn more about the subject they were working with. This was a very practical example of how much a practical experience with nature can improve the effectiveness of environmental education even with small children.

Suzuki and Dressel (p. 344-347) tell the story of Jon Young, the founder of the Wilderness Awareness Schools. A particularly telling part of the story describes how a second grade teacher had to yell at Young to divert his attention from a mesmerising butterfly fluttering past the evergreen outside the window. Young explains, "As I woke up from my dream of the outside world and looked at her, I suddenly realised for the first time that I wasn't free. The beautiful world outside was not for me; I couldn't go out and play. I was a prisoner. I actually felt my heart break." (p. 345) Young went on to study biology and ecology, but it was his training as a tracker by famous survivalist Tom Brown that mostly shaped his character and his motivation. He formed a very bleak view of the traditional school system: "Schools as we know them are not the only

way to become educated. They were invented by the Industrial Revolution, so that people in the countryside would learn to be obedient factory workers. That's the model we now force upon our children, and we wonder why so many of them are unhappy there." Then he says, "Put [children] on a computer, hook them up to an EEG, and you'll see there's a very localised little bit of the brain that's being used. Put them out in a yard, playing with a ball, catching frogs, climbing trees, and the electrical signals are moving all over the brain. [...] No wonder our culture has become unbalanced as well, and doesn't notice our actual three-dimensional reality, can't see how incredibly crazy it is to poison your own food or destroy your own air." His Wilderness Awareness Schools today try to teach people through outdoor education to recognise the complexity and the beauty of the natural world around them.

An incredible result of Young's outdoor and natural teaching approach is that children diagnosed with various "learning disabilities", from dyslexia to Attention Deficit Disorder, not only learn quickly, but actually do better than the others. After these positive experiences, they also tend to perform better in the traditional curriculum, because of the increased self-confidence. The beneficial effects of outdoor education to behaviour disordered students have also been reported in many scientific articles reviewed by Lappin (2000). The reported programs include not only expensive wilderness camping experiences, but also simple, near-school activities. That outdoor education helps develop a sense of environmental responsibility may seem obvious. But, as the digest of scientific articles by Rita Yerkes and Kathy Haras (1997) shows, there is also hard evidence that even "kindergarten children [can] understand environmental issues and citizenship responsibilities." The same digest lists some characteristics of programs most likely to change environmental behaviour: concrete, environmentally positive, action-oriented experiences; relevant context; application of learned material; and long-term involvement, among others. Finally, another digest by Judith Boss (1999) suggests that outdoor education and experiential learning can set students on a path of strong civic responsibility and help them grow into fully participating citizens of our society.

The present work draws on the above described ideas and findings and moves a step further, bringing the "outdoors" to the immediate vicinity, and partly even to the inside of the school. Instead of taking the students to the outdoors, the proposal is to bring the outdoors to the students. The hope is that the benefits of a close interaction with nature can be made available to students not just sporadically on field trips, but every day, the whole year around, in their own school.

Another example of a school that has gone the "extra mile" to teach environmental consciousness is Clackamas High School in Portland, Oregon. When the new school was built, the architects and school board took to heart the issue of teaching sustainability by example. The school building takes prevailing winds and seasonal sun angles into account, and uses the nearby wetlands to provide cooling. These measures, allied to carefully selected materials, allow the school to do without furnace heating or air conditioning 80% of the time, saving the school US\$50,000 per year (Suzuki and Dressel, p. 22). The school also uses all natural light and air, and integrated a natural bog on the school property with the school's water system, so that "grey" water could be naturally purified and reused. The water cycle and biodiversity of the bog were kept intact to be used both as a learning tool and as a source of contact with their local, natural world (Suzuki and Dressel, p. 353). The open eco-garden and the winter garden proposed in this project will also strictly follow sustainable guidelines for design, construction and maintenance. This not only makes good environmental (and economic) sense, but will also be a powerful learning tool for students and the neighbouring community.

The previous examples outlined projects that were restricted to single schools or school associations. In Curitiba, South Brazil, we find a large city of more than 2 million inhabitants applying the principles of practical environmental education in all its schools. Curitiba is by no means a typical city. It is considered a model of sustainability by the United Nations Centre for Human Settlements (Habitat). Habitat's press release of the Habitat II Conference (UNCHS, 1996) in Istanbul cites five successful projects in Curitiba as examples of "best practices":

waste collection by low-income families that gives food in exchange for waste;

increase of green space from .5 m² to 50 m² per capita through a combined water and park management program, which also reduced flooding problems;

a combined solid waste management/job creation program that had employed more than 4,000 people, treated 7,000 tons of waste and had cleaned up more than 450 hectares of public space by 1996;

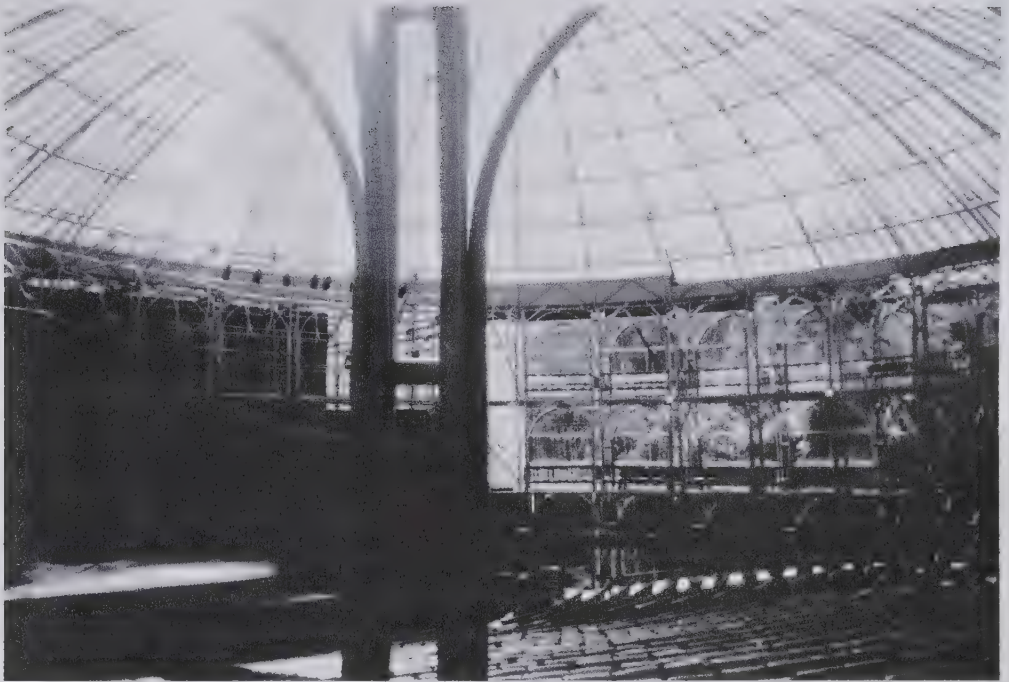
development of a large number of public libraries, equipped with modern computer technology suitable for young people;

and a revolutionary system of public transportation that resulted in 75% of Curitiba's commuters travelling by bus, despite having Brazil's second highest per capita car ownership. Curitiba's bus system uses concentric circles of local bus lines connecting five main axes that radiate from the city centre in a spider web pattern. On the radial express lines, triple-compartment, bi-articulated buses drive freely in their own separated traffic lanes (they also control the traffic lights), and carry an average of 20,000 passengers per hour. That is about as many as the subway New York carries, except that the bus system costs at least 100 times less.

Curitiba's secret, if it has one, is the reliance of its government on wide participation of the citizens. This has been a staple of the process that has transformed Curitiba since the early 70's. As a way to ensure that city development is understood, shared and influenced by all its citizens, education forms an essential part of the process. As a fundamental element of primary schooling, each child gets a set of the Curitiba Lessons, a ten-volume text on the city's history, culture, civics, and environment. The city's government sees schooling as only one element in an extensive network of child-oriented social services and education.

The Centres for Integrated Education have a program that offers meals and health-care at school for children from low-income families, but they also have emphasis on practical environmental education. Besides offering instruction to poor children on how to care for their younger siblings, they also teach how to grow vegetables. Older children are given apprenticeships, often in environmental skills, such as forestry, ecological restoration, and water pollution control. Boarding schoolchildren can earn half the minimum wage working in parks, flower shops, and private gardens. In other social programs, children learn gardening by growing flowers, then sell them to city parks, thereby earning money and self-respect, gaining skills and learning in practice the importance and how to care for the environment. One example of positive attitude change towards responsible citizenship and the environment was the solution to the problem of vandalism caused by local gangs on day-care centres and at the new Botanic Garden. Through patient negotiations, without police involvement, the gangs ended up recognising the value of what they were destroying, and getting involved in the care of the facilities. In the case of the Botanical Garden, the trouble youth were hired as assistant gardeners. (Hawken et al., p. 303, 304)

As the example of Curitiba shows, community involvement and transparency in decisions are essential, in addition to practical environmental education, to produce a long-lasting impact on the mind-set of society. Drawing from these lessons, the present project should ensure involvement of the neighbouring community from the earliest phases, and ongoing thereafter.



View from inside
the glass dome
theatre in Curitiba's
Botanic Garden

Sustainability in Edmonton

Edmonton is a city that is trying to lead efforts to protect and restore the environment. In 1991, City Council adopted an environmental mission statement, saying the city "is committed to conscientious and responsible environmental management, practices and stewardship in all aspects of its corporate activities."

As part of the implementation of this mission, the city has several programs for preservation of the environment, including a Greenhouse Gas Emissions Reduction Plan, a new Office of Energy Management, created in 2000 to promote energy conservation, and a plan for conservation of sensitive natural areas. Edmonton recently completed an intensification audit as part of their Urban Land Intensification Strategy to address the issue of urban sprawl. The next phase of the strategy will provide recommendations to City Council on how to regulate city growth based on the audit results.

However, it is in waste treatment and recycling that the city has advanced farthest and achieved greatest recognition. The Gold Bar Wastewater Treatment Plant has the world's first large-scale, medium pressure, high intensity UV disinfection facility, which eliminates 99.9% of the coliform bacteria in the plant's effluent. It also includes facilities for anaerobic digestion and biogas utilisation. This award-winning facility will be completed in 2003 with a tertiary treatment for maximum protection of river water quality.

Solid waste is also carefully dealt with through a variety of means. According to the city's Waste Management Department (Edmonton, 2002), a combination of recycling, composting and reusing enables Edmonton to divert 70% of its residential waste from landfill, more than any other major Canadian city. All the non-recycled residential solid waste is taken to a newly constructed Composting Facility. This state-of-the-art facility uses the City's household waste and bio solids (sewage sludge) as resources to create compost, and it is the largest plant of its kind in North America. In addition, approximately 27% of Edmonton homeowners (around 42,000 families) are composting in their backyards.

Since 1988 Edmonton has an active recycling program, which is recognised as one of the best in North America. Recyclables are collected separately directly from homes and through a series of recycling depots, and up to 18% of the city's waste is being recycled. The city's goal is to become the recycling capital of the Pacific Northwest. City officials are trying to attract recycling investments from around the world and to develop a recycling infrastructure to process recyclable products from the whole region. Among these there is a deal, reported in the Edmonton Journal (Olsen and O'Donnel, 2002), to set up a \$25 million computer recycling facility at the city's Centre for Waste Management.

Another way available to Edmontonians to reduce and reuse their residential waste is the Reuse Round-Up (Community Garbage Fair), an environmentally friendly community event held to collect household items for reuse and/or recycling, which is organised and supported by the city.

Edmonton has also a very active, environmentally conscious community, organising many activities and events to raise public awareness to issues of sustainability and environment preservation. A sample of these groups are the Garden Institute of Alberta, the Environmental Resource Centre, Destination Conservation, Nature Network, Mountain Equipment Co-op, and the John Janzen Nature Centre. Among the many events in Edmonton, there is an annual Energy Awareness Week , which is coupled to an Eco-Solar Home Tour showcasing many practical examples of high energy efficiency throughout the city. The Lawn-Be-Gone Tour, organised by the Environmental Resource Centre, tours several naturescaped gardens around town. The City also organises the Earth Day and the River Valley Clean-Up, involving the entire community in cleaning city's parks. This makes Edmonton citizens feel more responsible for their maintenance. The John Janzen Nature Centre organises yearly a Dandelion's Festival to fight the misconceptions, and inform the public about the importance and the many uses of this beautiful plant. It is also an opportunity to promote the use of native plants and organic gardening practices. These practices, along with a lot of hints, and native plant seeds to buy or to swap can be found in each of the several Edmonton Seedy Saturdays that occur in and around town. Another sign of environmental consciousness building up in the city is the fact that many schools stopped spraying pesticides in and around their grounds, and the city is now revising its policy for all schools in this regard.

In 2002 Edmonton hosted two major events: the 5th Annual Sustainable Building Symposium and the AltEnergy 2002 Conference. Both events provided valuable insights into recent advances in sustainability and energy conservation. These events also present vital opportunities to network with like-minded professionals, and raise the profile of the city at national and international levels.

All the previously described points would suffice to make the city of Edmonton an ideal place to develop the present project of a sustainable teaching facility for a school setting. In addition, however, the city has also introduced a new program, called "Naturescapes". Naturescapes comprises a wide range of projects and activities to promote school

greening. These include projects directed toward planting native plants, providing habitats for a diversity of animal and plant species, and sustaining healthier environments.



On tour with
the Energy
Awareness Week
in Edmonton

Several schools in Edmonton have implemented greening projects on their school yard as part of the Naturescapes program. This program is a collaboration between the City of Edmonton and the Edmonton Public Schools and Catholic School Districts and has attracted national attention. Evergreen Canada, a national non-profit environmental organisation, has recently established a school greening support program called "Helping Hands" through a sponsorship with Toyota Canada. Edmonton has been chosen as one of the recipient communities, because of its commitment to community/ school greening manifested through Naturescapes. This new program will support six city schools to produce and implement high quality, sustainable plans for school greening. As it will be shown in the next section, the Helping Hands program will play an essential role in the practical implementation of the present project.

Elmwood Elementary School

Elmwood Elementary School is a unique education school in West Edmonton that offers four distinct programs (Cogito, ISP, Early Education, and mainstream). The children of this school not only span several age groups, but also include children with different degrees of special abilities and skills. These children have a variety of needs and require a broad range of teaching skills and didactic materials.

For over a decade Elmwood School has maintained a strong commitment to ecological awareness with over a thousand environmental projects, culminating in its designation as one of Canada's Earth Schools in May 2001.

Elmwood
Elementary School
received an Earth
School award



Some examples of the vibrant environmental activity at the school are:

Recycling of phone books to raise money to adopt a Valley Zoo snake.

Collection of recycling paper from classrooms, and pop-cans and juice boxes for recycling.

Making of posters and presentations to raise awareness of environmental issues, such as the meaning of "recycle, reuse and reduce".

Researching and preparing lists of environmental activities that can be done by the classes.

Planting flowers in front of school.

Celebrating Earth Day with a school yard cleanup in April.

Participating annually in the Alberta Amphibian Monitoring Program (grade 5).

The participation in the Amphibian Monitoring Program consists in adopting a wetland and monitoring the presence and absence of amphibian species. Children learn about the species and their relationship to the environment and report their observations to scientists at Alberta Environmental Protection and Natural Resources Service, Wildlife Management Division.

Beside these activities, the school's Lunch program encourages garbageless lunches and recycling of all beverage containers. All classrooms take recycle, reuse and reduce very seriously, using recyclables in art, science and math projects.

Elmwood Elementary held a hugely successful computer recycling fair in June 2001 to give obsolete hardware to Elmwood families, rather than throwing them away. The school has also applied to the Alberta Computers for Schools Program and received 21 recycled computers. This way the "reuse" principle is being applied to its fullest.

Recently, the staff and parents of students have manifested their interest that the school provide more play equipment, better design for a play area and the possibility to handle and play with flowers and nature, in essence a naturescape. There is also a growing need for new, alternative teaching space and a science room. With the announcement of the Helping Hands Program, the opportunity to fund such a project presented itself. As the school officials learned about the innovative design being developed in the present project, they became immediately interested. The proposed design was able to address all the above cited needs at the same time. With full support and encouragement of the school staff, this project was adapted to the particular case of Elmwood

Elementary School and submitted to the Naturescapes/Helping Hands Program competition. The submission was successful and Elmwood Elementary was selected as one of the eight schools that will have their project supported through the Program.

Science Curriculum

The *Elementary School Science Curriculum* (1996) for the Province of Alberta prescribes the topics to be covered in the science program of the first six school grades. The program is comprehensive and is built upon children's natural curiosity about their surroundings. The aim is to better prepare students for life in a rapidly changing world with increasingly complex questions and issues to be addressed. The Curriculum's foresight recognises that the "decisions and actions of future citizens need to be based on an awareness and understanding of their world, and on the ability to ask relevant questions, seek answers, define problems and find solutions." (p. A.1)

Whether the creators of the Alberta Science Curriculum were thinking about the same interconnected, holistic understanding of the world, as the one being advanced in the present project is not clear. What is clear is that the proposed combination of an eco-garden and winter garden/science classroom seems to fit perfectly with the curriculum structure proposed for science in the first six grades.

To be more specific, the Curriculum lists five topics for each grade to be covered during the year. It also emphasises the importance of involving the children in practical activities related to the topic. It is possible to identify several topics, which could be easily related to eco-gardening, alternative energies, recycling and other environmental and sustainable activities:

Grade 1: Seasonal Changes; Building Things; Senses; Needs of Animals and Plants.

Grade 2: Exploring Liquids; Buoyancy and Boats; Hot and Cold Temperature; Small Crawling and Flying animals.

Grade 3: Rocks and Minerals; Building with a Variety of Materials; Testing Materials and Designs; Hearing and Sound; Animal Life Cycles.

Grade 4: Waste and Our World; Wheels and Levers; Building Devices and Vehicles that Move; Light and Shadows; Plant Growth and Changes.

Grade 5: Electricity and Magnetism; Mechanisms Using Electricity; Weather Watch; Wetland Ecosystems.

Grade 6: Air and Aerodynamics; Trees and Forests.

In summary, all parts of the science curriculum will benefit from the new learning environment, which will actually serve as an outdoor/indoor science classroom that can be used all year around. The fact that the new combined gardens will be used by all groups of students in their regular classes, irrespective of their age, will contribute to remove any sense that this special environment is for preferential use by any group. The sense of ownership, responsibility, pride and care will be equally shared by all, which should significantly minimize the potential problems for the maintenance of the facility.

Scope of the Project

This project consists of the development of a design concept for an alternative learning environment in the form of an eco-garden/classroom combination, and its practical application to the particular case of a

science room for Elmwood Elementary School in Edmonton. The concept and principles guiding selection of materials, design and use of the combined eco-garden are elaborated and discussed extensively. However, the structural and construction details, as well as the detailed choice of materials are beyond the scope of this work.



Design Approach

School-age children typically spend a large part of the day in school. Although they receive most values from their parents as they build their own value system, a substantial part is also acquired at school through teaching, and through interaction with the environment and other children. If their classroom is a dull, plain space, they would be deprived of the kind of stimulus they need for their development. A featureless room may seem soothing and unthreatening at first, and many are deliberately designed to try to focus children's attention on the teacher, but they actually amount to agents of sensorial deprivation that numb the students senses and curiosity. "Because this artificial environment is so unnatural and constrained, normal emotions and values that have been repressed [may] surface as aberrations, like blades of grass popping up through a pavement." (Suzuki and Dressel, p. 318)

We know that young children can easily become impatient when there is not a wealth of stimuli to catch their interest. When left alone, they head straight to the mud puddles, piles of leaves, puppies or small bugs they can find. They have a natural desire to explore and investigate, see inside things and find out how things work. A rich natural environment, even a small one, can keep them busy for hours exploring its minute details. This is the principle behind the use of outdoor education. The Wilderness Awareness Schools, mentioned in the previous chapter, are a marvellous example of how to give students all the benefits of outdoor education. A cornerstone of their teaching is called the "secret spot". It is a place in nature, which may be as simple as a suburban back yard, where a person can go every single day and be fully present. There, the students learn to observe every small detail of what is happening in the natural world (Suzuki and Dressel, p. 345). The combined eco-garden and winter garden in this project will be full of life, offering students a "secret spot" in their own school, stimulating their senses, challenging

their imagination. By bringing the complexity and diversity of nature into the school environment, the gardens will help the students achieve a more balanced intellectual and behavioural development (Yerkes and Haras, 1997, Boss, 1999, Lappin, 2000).

Field Research

As part of my field research, during the winter of 2002 I followed for a month a Grade 1 class of the Child Study Centre at the University of Alberta as they were learning about their natural environment. The children were involved in a gardening project, following Dr. Sylvia Chard's methodology of the Project Approach (Chard, 1998 and 2002). I had the opportunity to closely observe and interact with the children as they worked and studied about plants and insects, while at the same time handling them. A sequence of teaching/learning activities followed well organised steps, as outlined in the Project Approach guides (Chard, 1998), and briefly described as follows.

The first class was dedicated to conversation with the children about the project theme ("gardening"). The discussion culminated with the elaboration of a *topic web* showcasing all words that the children could remember relating to the theme. This topic web represented the ideas and impressions about gardening that the children had before the beginning of the project. The whole process of producing this web was equivalent to a brainstorming session by the children. The richness of the results reveals the impressively broad range of interests shown by the children.

The next step consisted of collection of materials related to the selected topics. Children were asked to bring something from home and were also allowed to collect on site. The collection was then displayed on a mural.

The preparations were then followed by a "field trip" around the University of Alberta campus. During their walk, the children were actively looking for items they had listed in the topic web, such as buds, flowers (dandelions), trees, insects, rocks, soil, etc. The field trip was ended with an open discussion with the teachers about their findings.

In the next session after some introductory explanations, the children began to care for and follow the growth of seeds, caterpillars, and tadpoles in transparent plastic containers.

They dedicated a lot of time to observation and analysis of these growing creatures. They also talked, wrote essays, and made drawings about their favourite plants, and insects. In all subsequent sessions they continued to follow the growth and change of the animals and plants with such care that they even spoke of them as their "pets".

In another session the children listened to stories and told stories themselves related to gardening. They also enjoyed watching a video and listening to music related to the theme, even dancing to the songs, showing they were completely comfortable participating.

Towards the end of the project a session was dedicated to composting and multi-sensory experiences. After learning about and practicing composting in the backyard just outside the classroom, they analysed several textures, shapes, and smells of plants, trying to classify them according to these aspects.

The final step of their project was an exposition and presentation to parents and teachers (their closest "community") of all the materials collected and produced during the project. It was a lively and enjoyable event, including the release of their butterflies.



Learning with
nature through
the Project
Approach

During the course of the project, the children enthusiastically followed the parts that involved growing caterpillars into butterflies, and the walks about the campus. They showed a keen interest, especially in living things, such as insects, buds, and flowers, but also in the natural soil. They clearly enjoyed every part, while they were learning.

The children became so motivated by working with nature that their interest and curiosity led them naturally to "research", that is, to want to learn more about the subject they were working with. They spontaneously reached for books and asked questions, absolutely interested and captivated by the topic. They learned through experimenting, touching and feeling the texture of plants, feeding the caterpillars, watering the tadpoles swimming in the pool, planting seeds and caring for them, and working with composting. I could witness an extraordinary interest from the children in all the activities involving nature. Through their hands-on experiences, the learning process just flowed naturally, smoothly, and effectively. Plus, the children appeared to be really enjoying all of the activities. They were assisted by the teachers, but at the same time they were showing numerous initiatives of their own.

These opportunities to observe children in practice, while they were learning with nature were invaluable for this work. Several features of the resulting design were influenced by my observations of these classes. For instance, I noticed that they didn't enjoy being under direct sunlight for very long. They made this very clear, actively looking for shade while outside. So, the new learning environment will have special sunshades, inspired by the shape of trees, to address this need.

Another part of my field research consisted of a visit to architect Stephen Carruthers in Calgary, who has considerable experience in sustainable building design. His critical appraisal of an early version of this project included pointing out sustainable certified choices of materials. This project benefited from the very productive brainstorming session during the visit, which resulted in several ideas implemented in its latest versions, such as the use of triple glazed, low-E glass, with argon fill between layers, and titanium coating. We also discussed the advantages and disadvantages of using aluminium versus wood for the window frames.

I also visited the Environmental Resource Centre, where I had the opportunity to talk to environmentalist Chris Ford. Our conversation was

very productive, due to his in-depth knowledge about eco-gardening and naturescaping in Edmonton. Chris Ford advised me on the types of plants that should be introduced, which will be described later. He also motivated me towards involving the neighbouring community early on in the project, so they will develop a sense of participation in it.

Yet another valuable instance of field research was a visit to the Alberta Home Heating Research Facility (AHHRF) of the Department of Mechanical Engineering of this University. Situated off campus in the south of Edmonton, the facility consists of 6 houses specially designed for testing various heating, ventilating and energy conservation strategies and technologies. Many of the experiments conducted there over the years had direct influence on building code standards. The visit was hosted by Dr. Doug Dale, one of the main investigators involved with AHHRF. Among the many scientific conclusions he described was the efficiency and reliability of the use of a rock bed for thermal storage. This project includes a similar rock bed underneath the winter garden.

A New Learning Environment

This proposal addresses the need for a more intimate contact with nature through a combination of an open garden and a winter garden, and follows the principles of ecological and sustainable design. The proposed innovative learning environment will not only serve as alternative teaching space and playing ground, but will also enrich the children's educational experience, through teaching by example.

The open garden will be mostly developed as an ecological garden with mini-wetland and outdoors classroom, made of local native plants. These plants can be enjoyed all year long, are of easy maintenance, and require no use of fertilizers or pesticides. This kind of garden will attract all sorts of small wildlife existing in the neighbourhood, such as birds, squirrels, rabbits, butterflies and others. The children will be able to study and play in a safe and pleasant natural environment, and at the same

time enjoy the interaction with plants and animals, learning to preserve and respect them. Teachers can use the eco-garden to offer a more lively learning experience and address science and social studies curriculum outcomes, taking advantage of the seasonal changes in nature. The Elmwood community will also benefit from the development of this community eco-garden, as it will bring nature, life and beauty to the neighbourhood. This open natural garden in the middle of a residential area is naturally inviting for a walk, a conversation, or simply contemplation.

The winter garden is conceived as an ecological learning environment. It will provide year around opportunities for the children to enjoy, play and learn through handling with plants and flowers, planting and growing their own. The effects of light and shadow, the smells, colours, and textures of flowers, plants and humid soil will stimulate all the students' senses, allowing for a holistic sensory learning experience. The pleasantly sunlit space will also attract students looking for inspiration or simply for a nice place to socialize.

From an educational perspective, the winter garden will create an out-of-classroom space that can be used year around as science room, where children can learn about natural resources, and natural ways of living and caring for the environment. It will offer an ideal place to experiment with alternative sources of energy, recycling, and composting techniques, along with the regular science and social studies curricula. The combined winter garden and eco-garden will be a long-term facility that can provide children with numerous and valuable opportunities for playing, exploring, enjoying and learning about and with nature. It will also generate ecological awareness and opportunities to community social action to students and the Elmwood community.

Important aspects of sustainability that will be taken into account for the developed design include:

Minimising building material and energy consumption;

Maximising use of renewable materials and energy resources;

Avoiding use or production of toxic or hazardous materials;

Reducing waste;

Recycling waste in the short term, and recycling building materials in the long term;

Emphasising durability and longevity of materials and components.

Xeriscaping.

Natural water collection.



Project Details

The construction of the combined eco and winter garden is proposed for the area adjacent to the parking lot in the back of the school. This area is in need of redevelopment and offers sufficient space for the project. Most of the area will be occupied by the open eco-garden. The supporting winter garden will complement the eco-garden, being surrounded by it and at the same time attached to the existing school building.

Winter Garden

The winter garden and the adjacent classroom form a single environment, which is primarily to be used as science room. But it will also serve as a point of contact with nature that can be used even during the cold winter months. The design of the winter garden/classroom will follow all principles of sustainability described above. More than being just a new "green building", which is how sustainable buildings are currently known, the facility will be a demonstration unit for the school and neighbouring community of the practicality and benefits of these principles. But more importantly, it will be a powerful tool to counter the perpetuation of the old values of waste and carelessness in the schoolchildren. Instead, they will be encouraged to love and to care for the environment, and to recognise the beauty of the natural over the artificial world.

The winter garden will be designed to blend in with the existing school building. The existing building has a very interesting shape both inside and out. The recurrent theme includes concentric circles intersected at right angles by straight radial lines. The shape of the winter garden follows the same theme and harmonises with the rest of the building, forming a unity with the whole school.

The shape and orientation of the winter garden will be determined not only by its function and aesthetics, but also in order to optimise the use of solar energy for heating and cooling. Solar energy techniques can be subdivided in two basic categories: active and passive. Strictly speaking, passive solar systems do not require any other non-renewable source of energy to function, while active systems require the assistance of pumps, or fans, which are usually powered by electricity. Although these active components consume non-renewable energy that we are trying to minimise, they can often increase the efficiency of a passive system, thereby resulting in larger overall gain in solar power. This project will make use of a combination of both systems, the so-called hybrid approach.

The use of passive solar techniques to derive heating and cooling benefits from the energy freely available in the environment depends on two fundamental material properties. One is the ability of certain materials to store heat and release it slowly at a later time, and the other is the ability of glass to transmit solar radiation (light), but to remain opaque to thermal radiation (heat).

There are many handbooks and practical guides about the use of solar energy in buildings, for example, Montgomery (1982), and Levy et al. (1983). Montgomery's guide contains a wealth of charts, and formula sheets for calculation of dimensions and costs of solar energy systems. Levy's handbook concentrates in passive solar design and presents a comprehensive array of solar energy systems with detailed characteristics, advantages, and disadvantages. In general, the literature describes solar energy systems as consisting of five interacting components: a) a collector that admits solar radiation (glazing), b) an absorber that converts solar radiation into heat (dark surface), c) a storage medium that retains the heat (wall, or heating fluid), d) distribution component that transports and releases the heat at the desired location and time, and e) the controls (air circulation, shading) that enhance gains and prevent losses. These components are present in all systems, but their design and material varies from system to system.

The design shape of the present winter garden combines different types of passive and hybrid solar systems. By allowing direct access of sunlight into the adjacent classroom, especially in the winter months, the facility makes use of direct gain of solar radiation. The direct gain system makes use of regular walls and furniture to convert and store solar energy in form of heat. Distribution of this heat occurs mainly by natural convection into the same environment, which is the classroom itself. This is the simplest form of harnessing the heating energy of the sun, but is usually also the least effective, playing only a minor role in this project. The only form of control required by the direct gain system is the shading that reduces the heat load during the summer months. This is accomplished by the rolling shutters in the upper part of the glass wall.

Another solar heating system included in the present project is the thermal storage wall. The thermal storage wall is a passive solar system in which solar radiation is absorbed and stored in a special wall separating the collector region from the heat release region, which are the winter garden and the classroom, respectively, in this case. Normal thermal storage walls separate completely the two regions, and they are called vented or Trombe walls if the air is allowed to circulate from one region to the other. Since in the present project the thermal storage walls are only half height walls, their effect is closer to a Trombe wall, transferring heat to the room through thermal radiation and natural convection. For optimal heat storage, the wall will be made of concrete bricks that are solid, or hollow with grout-filled cores. The walls should be finished with a dark coloured, non-fading paint or stained masonry to maximise solar radiation absorption and heat irradiation. These walls can also be filled with soil, and be used as planters.

The winter garden itself will play an important role in the solar heating and cooling of the new learning environment. It constitutes a so-called attached sunspace that is not thermally isolated, but is coupled with the classroom space and has also to be kept within the comfort range of thermal conditions. During normal operation while the sun is shining, solar radiation is absorbed by the plants, soil and furniture in the winter garden, and released to the garden environment in the form of heat. The

warm air will move freely to the adjacent classroom warming up the whole room. But the openness of the winter garden is a disadvantage at night or during prolonged cloudy weather, when heat from the room will tend to be transferred to the winter garden to keep its temperature in the acceptable range. This requirement will likely cause the need of some form of auxiliary heating system to be utilized in the winter. To avoid excessive loss of heat, the rolling shutters should be used in these situations to act as an additional insulation layer. The rolling shutters will be made of insulating material and will be mounted coupling with the window framing. In the summer, because of their large radiation collection area, attached sunspaces are particularly susceptible to overheating. This makes control of the solar heat gain through shades and ventilation a critical element of this system. There should be an automatic control system to operate the shutters and louvres according to the requirements of heating, cooling or insulation without continuous human oversight. However, since every automatic control has its limitations, provision should be made allowing for a manual override to the system.

Finally, the use of solar energy will be further optimised by the employment of an active convective loop system coupled with a rock bed for storage and delayed release of heat or cold. Convective loop uses the fact that warm air is less dense than cooler air and tends to flow upwards due to buoyancy forces. This effect will produce a natural circulation of the air when the winter garden is receiving solar radiation. During the winter time all vents will stay closed and the warm air will circulate to the classroom, while the cooler air goes back to the garden to be warmed up again. If more heating is needed, the solar collector units can transfer heat directly to water radiators in the room. Most likely, however, additional heating will be required when there is no solar radiation at night, or on cloudy days. For that purpose, the solar collector units will work continuously during the winter, storing their heat in the rock bed storage system located underneath the winter garden. When additional heating is required, fans blow cold room air through the rock bed, where it is warmed up, and returned back to the room.

During the summer period, when cooling is required, the convective loop will be opened up and redirected to reduce the room temperature. For that purpose, vents will be opened at the bottom and top of the windows, allowing cooler external air to enter through the lower vents, and warm interior air to exit through the upper vents. Fans in exhausting mode will be activated on the ceiling to force the cooler fresh air to circulate through the classroom before exiting. During spring and fall the outside air in Edmonton is usually cold enough to remove the required heat from the ambient through this simple fresh air circulation. When the outside air becomes unable to reduce the classroom temperature, as in the hot days of summer, the rock bed storage system will be used. Additional fans will blow cold fresh air during the night through the rock bed, cooling off the rock, and effectively storing the cold for release during the day. When the outside temperature rises above the comfort level later in the day, the fans again blow the external air first through the rock bed, this time cooling off the air before it is directed into the garden and classroom. Alternatively, the vents can be kept closed during this period.

The position of the winter garden on the south side of the building is constrained by the position of existing classrooms to be combined with the garden. Fortunately there is one classroom, which allows the orientation of the winter garden to be practically due south. This choice results in the best aesthetical blend of the winter garden with the forms of the existing building, at the same time allowing for the highest solar energy efficiency in the room.

The windows on the south wall are of critical importance, because of their large surface area and their role in the passive solar heating of the winter garden and the classroom. In recent years the technology for energy efficient windows has advanced quite significantly, resulting in improved insulation, solar gain, durability, and low maintenance. These results are achieved through a combination of several technological enhancements. The most traditional improvement is the use of multiple glazing to reduce heat losses. While double-glazed windows have been used for many years, and are even mandatory in many European countries, triple-glazed windows are now the state-of-the-art and are

recommended for heating-dominated climates, such as in Edmonton. To reduce the heat losses through conduction and convection from one window pane to the other, the enclosed space between the layers should be filled with a less conductive, more viscous gas, than air. Among the alternatives, Argon is preferred, because it is also inexpensive, non-toxic, odourless, and non-reactive. Another important component of the large windows on the south wall is the frame material. Because the framework also has structural function, an aluminium frame, which is robust, extremely durable and low-maintenance, will be used. However, aluminium is highly conductive and a simple frame could cause increased heat loss, and severe problems of condensation and even frost on the inside surfaces in the winter. This problem is solved by the use of a "thermal break" that splits the frame components into interior and exterior pieces, and joins them with a less conductive material.

The most recent advancements in window technology are the so-called low-E (low emittance) coatings. These are special coatings applied to glass that selectively filter radiation, allowing visible light to go through, while reflecting most of the UV and infrared parts of the spectrum. Window coatings used to be transparent polyester films applied to the window glass after manufacturing. They have, however, limited durability, and often suffer from improper application. Most recently, microscopically thin, virtually invisible layers of metal or metal oxides are deposited directly on the glass surface during manufacturing. These coatings are essentially part of the glass itself and never wear off. For the present project, a high-solar-gain low-E Titanium coating applied to the inner side of each glazing would be ideal. This particular coating filters almost all harmful UV radiation from the sun, but allows most of the visible light to pass undeterred. The high-solar-gain version of Ti-coating offers the best compromise in allowing the heat radiation from the sun to enter, but blocking the heat radiation from the interior from exiting by reflecting it back to the room. This combination results in a maximum passive solar gain without increase in heat losses through the glass.

A new type of coating, which only entered the market by the end of 2001, is a titanium oxide layer that makes the glass self-cleaning. The coating reacts chemically with UV light from the sun to loosen and dissolve dirt. At the same time, this coating causes water to spread (water-sheeting), carrying dirt away more efficiently without leaving any "spots" caused by droplet evaporation. Such a coating applied to the exterior side of the windows would reduce maintenance in the present project dramatically, because it only needs to be cleaned once or twice a year with a simple hose and never wears off. Although not essential for the functioning of the winter garden, this feature may prove worthwhile given the large windowed area of this project.

Summarising, the windows will consist of triple-glazed, argon filled, high-solar-gain, low-E Ti-coated glass in an aluminium frame with thermal break. Optionally, the windows can also be externally coated with a self-cleaning TiO layer.

In general, east and west side walls do not contribute to solar heat gains, losing more heat than they are able to collect (Levy, p. 131). Therefore, the side walls of the winter garden will be made of well-insulated, opaque materials.

The main school building, which houses the classroom as part of the new environment, has a large flat roof that is likely responsible for the major portion of the heat losses in winter. This is due to its area being the largest and the most exposed to the wind. As part of the sustainable adaptation of the new winter garden/classroom facility, this project proposes the transformation of the main building roof into a "green roof". Green roofs are well-known for their stabilising effect on the roof temperature, dramatically reducing variations and allowing for higher average temperatures in winter and lower averages in summer. Besides improving thermal insulation and stability, green roofs also help reduce storm water runoff, a major problem in all cities, and improve air quality. The importance and advantages of green roofs are slowly getting more attention in Canada and recently the Canada Mortgage and Housing Corporation together with the Ontario Association of Architects issued a

report with guidelines for green roof design (Peck, 2002). Of the two types of green roofs (intensive and extensive) the extensive green roof is the best suited for the present project, because of its low weight, low capital cost, limited plant diversity, and minimal maintenance requirements. The light weight of this green roof generally does not require roof reinforcement. The green roof is composed by a few specialised layers of waterproofing, drainage, and root retention materials, covered by an engineered growing medium that may or may not include soil, and a relatively limited choice of plants. Typically, extensive green roofs rely on a mixture of grasses, mosses, sedums, sempervivums, festucas, irises, and wildflowers (Peck, p. 13).

Esquematic
View of
Proposed
Building
Annexed

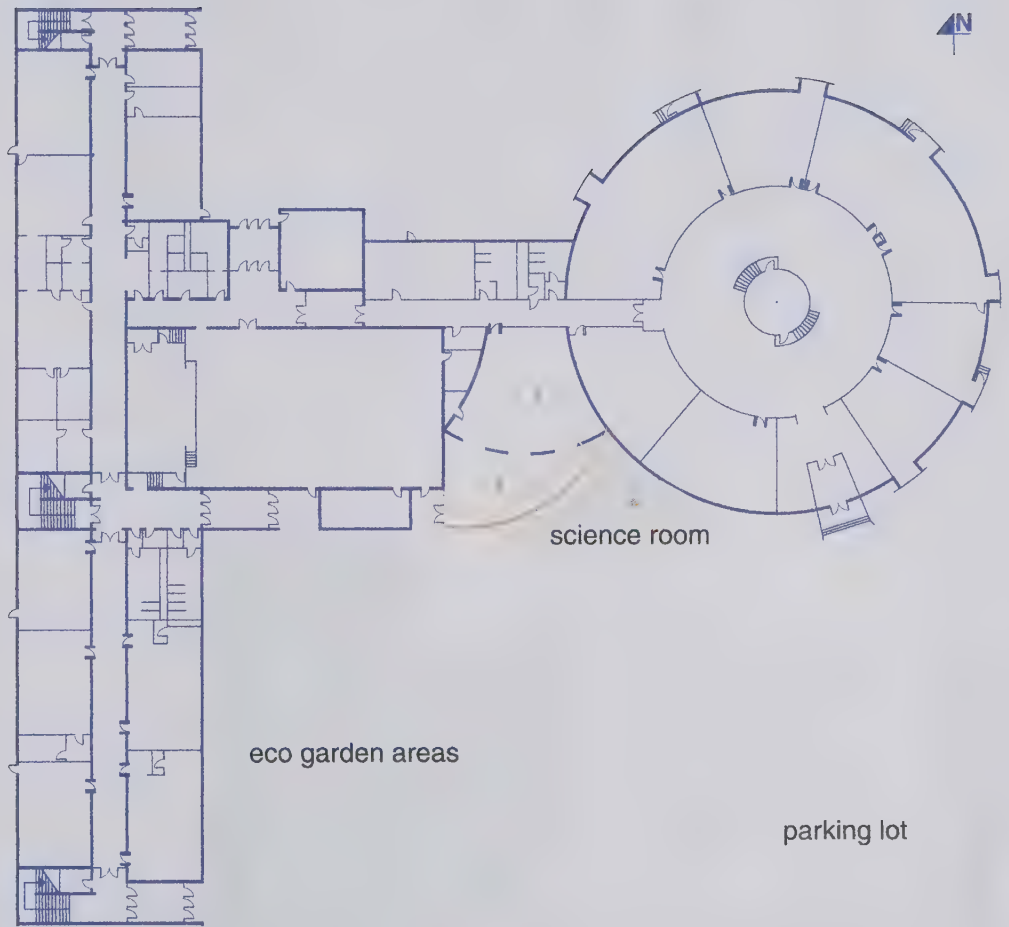
View from East



The winter garden will require a set of interior furniture, such as cupboards, working benches and planters. Similarly, the classroom will require boards, cupboards, shelves, tables and chairs. The furniture material will be carefully selected to satisfy the principles of sustainability and safety. As a practical example of sustainable technologies and design, the project will use only non-toxic, recyclable, and environmen-

tally friendly materials. Whenever available preference will be given to reusing existing furniture. Because of the specific nature of this project, safety will be a paramount concern and all parts will comply with the highest standards for child use.

Consideration should be taken in the selection of engineers and builders for the actual construction to ensure that they are committed to the principles of sustainable design that make the essence of this project. Increasingly these professions are being certified for sustainability standards.



Schematic
Floor-Plan of
the existing
building
(blue) with
the Proposed
Building
Annexed
(orange)

Top View of
Elmwood
Elementary
School with
Winter
Garden
Attached
(lighter gray)



Top view of Elmood Elementary School with Winter Garden Attached

South View



South View

East View



East View

North View



North View

Eco-Garden

The exterior part of the project will consist of an open eco-garden that covers a larger area behind the school, surrounding the winter garden. This requires removal of the existing tarmac coverage, and development of the eco-garden in its place. This location of the garden relative to the school building is ideal for protection against the predominating north-west winds in Edmonton. In addition, the south orientation of the garden allows it to maximise the use of sun light without interference from the building. If a tarmac covered area is still needed for recreational activities, it should be relocated since, in contrast to a living garden, it does not require maximum wind protection and sun exposure. The area north, in front of the school, will also be receiving some eco-landscaping.

The eco-garden corresponds more closely to a naturescape, such as the ones being implemented by other schools in Edmonton with support from the City, only that in this case, exclusively native plants will be used. The native plants will include a mixture of trees, bushes and grasses. Particular care should be taken in the placement of perennial trees, in order to avoid shading of the adjacent winter garden, whereby its efficiency would be reduced. By suggestion of environmentalist Chris Ford, flowering plants should consist mainly of early blooming varieties, such as prairie crocus, harebell, and clematis, in order for the children to enjoy the flowers before they go on summer break. The winter garden will serve as support for the open eco-garden for the initial period of cultivation of several plants from seeds. Since a normal garden does not offer the same protection that native plants usually find in the wild, the winter garden needs to play this role until the plants are big enough for the open garden. There should be sufficient space left in the garden for its expansion with plants grown in the winter garden as part of students' projects.



Winter and
Summer Views of
the Sites to be
eco-scaped, as
they are now

An outdoor classroom in the form of an amphitheatre will be formed by raised planter beds in the eco-garden. The outdoor classroom will have special wheelchair access and will blend smoothly with the rest of the garden. The issue of sun protection and shade, raised consistently and emphatically by the children during my field research described in the previous chapter, will be addressed with a series of specially designed sunshades, inspired by the shape of trees. These shades are made of separate canvas panels that form a set of individual awnings. Each panel can be easily adjusted by setting the supporting rods in wormholes of different heights on the trunk. The trunk and the supporting rods are of light weight bamboo, so that the sunshades can be effortlessly transported and installed by the teachers in predetermined spots around the outdoor classroom. The individual control of panels allows for easy adjustment by the children to varying sun conditions, and results in an attractive and natural looking staggered pattern. The sunshade materials, bamboo and canvas, are all natural and unfinished, which is the most appropriate for this setting, besides being environmentally friendly. The eco-garden will also include a mini-wetland with frogs and one or two bird houses. An interesting practical project involving the bird houses will be to cover them with a small green roof. This would help children to learn about and understand the principle and benefits of green roofs.

The eco-garden is intended as an open, long-term, and ongoing project that should involve all the school and neighbouring community.



At the Evergreen/
Helping Hands
Design Workshop,
students
experimented with
placing, designing
and building
models of their
favorite items for
the school garden



Discussion

The implementation of this project will involve the school community and neighbourhood in all decisions from the early phases of implementation on. This cooperative effort will help to identify particular needs, or issues that need to be addressed before the implementation of the project, thus minimising the need for fixing avoidable problems, which results in higher costs afterwards.

The discussion with teachers, students, and all the beneficiaries involved also results in a sense of ownership in the community, as opposed to feelings of alienation and interference caused by a top-down imposed approach. The neighbourhood should be invited to collaborate, work, visit, make suggestions, and enjoy all phases of implementation of the project. This cooperative approach is essential to the long-term success of this project.

Also important is the continuous involvement of all stakeholders with the project. This community participation can be in the form of fairs, and distribution of a printed newsletter with the latest developments and future plans regarding the project and involving the community. Ideally, the new facility would become a permanent place of contact and interaction between the neighbourhood and the school for social and environmental activities.

In fact, the school committee has already taken the initiative and conducted a survey of children, parents, and teachers about their priorities and suggestions with respect to the naturesscaped eco-garden. The results of this school survey, reproduced in the Appendix, offer an encouraging support to the present proposal. Among the priorities chosen, a mini-wetland in form of a pond, birdhouses and feeders, trees and wildflowers were in full agreement with the proposed design.

The discussion process about the implementation has also been started in the school committee. Preliminary evaluations of the present project by this committee produced suggestions and raised some issues of possible difficulties in the project implementation. One of these difficulties seems to be the relocation of the tarmac covered area. Although there is a clear design advantage, or even necessity, in the proposed location of the eco-garden, there are objections from participants to the tarmac relocation. These objections will all be considered as the project implementation evolves.

Similarly, there are two rooms being considered for the conversion into science room/winter garden. While the discussion process is expected to take some time, because of all the practical considerations and preferences that must be accommodated, I decided to settle for the use of the current music room for the sake of this work. My preference is based on the fact that the winter garden addition blends better with the forms of the existing building in the proposed position. The resulting structure has a more simple and elegant shape, and the general effect is very pleasant. The due south orientation of the room has also a clear advantage in terms of energy efficiency, compared with the more than 20 degrees inclination of the alternative classroom. The use of this room could require relocation of the music room and some renovation work to level out the floor, however, music could be integral with the garden setting.

The final placement of the winter garden, as well as the eco-garden, will be a result of the open discussion process described above, involving all interested parties. The present text should be seen as the starting point for this process.



Teachers,
Parents, and
Students work
together,
evaluating the
sites and sharing
their opinions

There is also another aspect of relevance to community involvement. The large glass surfaces of the winter garden, although not visible from the street, are easily accessible through the school's parking ground on the back, and vulnerable to vandalism. But, here again the example of Curitiba is inspiring. The bus stations along the express bus lanes are specially designed tubes made of glass and Plexiglas. These fragile constructions, called Tube Stations, are never subject to vandalism, because of the pervasive civic pride of the Curitibaans. They were respected and listened to during the entire development of the transit system. Now, their feelings of ownership and pride make them guardians of this symbol of their town. (Hawken et al., p. 294) In the same way, this project envisions the whole neighbouring community participating and consequently taking care of the facility. The constant reminders that this new learning environment is theirs and is special will be the best deterrent against any vandalism.



Conclusion

The combined eco and educational winter garden will give Elmwood School the opportunity to enter the fast growing circle of environmentally active sites. The importance of environmentally conscious behaviour will continue to grow with time. By seizing this opportunity, the school can become a focal point for promotion of ecological activities involving the students and the community. This will generate a wide palette of exciting activities and events for the students to participate in. With this unique facility Elmwood School will be leading the group of environmentally active schools, a trend that is sure to have an impact on all schools and contribute significantly to an enriched education. The hope is that this pilot project will become a model for a new generation of naturescapes, and that these learning environments will positively impact the minds of many children, ultimately turning the tide toward a sustainable society.

I anticipate a further study to follow up the construction at Elmwood Elementary School. It will be important to document the development of educational programs in this new environmentally designed area of the school.

FAB Gallery Exhibition





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Appendix



All Hands in the Dirt - Template 2

Student Questionnaire

Part A — How Students Use the School Grounds

What times of the day do you play in the school grounds? _____

What do you do when you play in the school grounds? _____

What do you like to do best? _____

What do you play with? _____

Where do you play? Why? _____

Where don't you play? Why? _____

Are there places to get out of the wind, rain and sun? _____

Are there places where you can sit quietly to talk with a friend or read a book? _____

Part B — How Students Feel About the School Grounds

What are the things you like the most about the school grounds? _____

What are the things you don't like at all about the school grounds? _____

Do you have a favourite place in the yard? What makes it special? _____

Are there any places where you don't feel safe in the school grounds? _____

What would you like to be able to do in the school grounds that you can't do now? _____

What would make our school grounds more interesting? _____

Are there places that you think could be made more colourful? _____

Make a wish list of things you'd like to include in the school grounds. _____



All Hands in the Dirt - Template 3

Teacher Questionnaire

Part A — How Teachers Use the School Grounds

Which areas on the grounds do you presently use to meet the demands of the formal curriculum? _____

What do you teach in these areas, and at what time of year and how often? _____

Are there any parts of the grounds that aren't used? Why? _____

Which curriculum subjects do you see being reinforced by the development of the grounds? _____

When the grounds are developed following criteria set by you and the other teachers, will you be more likely to use the grounds as an outdoor classroom for a variety of subjects? If yes, for what subjects? _____

What are your recommendations (for example, changes, additions, deletions) in order to improve the grounds so that they may be used more fully to meet the demands of the formal curriculum? _____

Part B — How Teachers Feel About the School Grounds

What comes to mind when you think about the school grounds? _____

Which aspects of the grounds do you think are an asset? _____

Can you identify problem areas on the grounds and explain why they are a problem? _____

Do you have any current concerns about supervising the school grounds? _____

What do you find esthetically pleasing about the present site? _____

What improvements would you like to see in the future? _____

Would you be willing to devote class time to the maintenance of the grounds if outdoor classroom development and use were integrated into the curriculum? _____

Please provide name if interested in helping: _____



All Hands in the Dirt - Template 4

Parent Questionnaire

We are currently looking at ways to improve our school grounds and would like to know your views on the area. We would appreciate it if you would complete this questionnaire and return it to the school through your child by (date) _____

Name (optional): _____

Phone Number (optional): _____

What do you think of the school grounds?

Are there any parts you like? Why?

Are there any parts you dislike? Why?

What do you think about the way the school grounds are used?

Which parts of our school grounds do you think your children particularly like? Why?

Which parts of our school grounds do you think your children dislike? Why?

Is there anything about our school grounds that causes you particular concern?

Any other comments?

Please return to _____

Naturescape Priority Survey Results

Thank you for taking the time to complete this important survey. Here are the results from the 115 returned surveys:

25 - Covered gazebos with seating	32 - Picnic tables
19 - Murals on walls	45 - Birdhouses/feeders
11 - Pond	1 - Birdfeeders
18 - Pond with bridge	32 - Fruit trees
20 - Fish pond	29 - Evergreen trees
45 - Tree house	24 - Sunflowers
48 - Decorative fountain/waterfall	37 - Wildflowers
5 - Waterfall	2 - Dog path
36 - Fish pond with bridge	19 - Shrubs
31 - Pathways	28 - Weather station
54 - Rocks to sit/climb on	32 - Garden swing

Comments from Naturescape Priority Survey Results

- ☐ No dog path due to feces potentially being tracked into building.
- ☐ Project should be cost effective, relatively *maintenance free*, attractive and least tempting to vandalism.
- ☐ Every child brings a plant to be planted.
- ☐ Every class provides plants based on their theme (grasslands or grasses, Aspen parkland, trees, shrubs, flowers, berries).
- ☐ Incorporate as much scholastic use as possible.
- ☐ Should be drought resistant.
- ☐ Avoid anything that would add to litter—picnic tables, dog paths.
- ☐ *Brilliant idea!*
- ☐ Families “buy a tree” with names painted on an outside “Donor Wall”.
- ☐ Safety of garden swing?
- ☐ Wildflowers spread easily and can quickly become just weeds.
- ☐ *Water-related areas need to be safe (enclosed).*
- ☐ Keep it natural.

Comments from Naturescape Priority Survey Results—Continued

- ☐ Although ponds are not very suitable for our climate, they do provide a great learning experience.
- ☐ Most of the ideas are ridiculous and pose safety hazards.
- ☐ Rocks need to be large enough so as to not be moved.
- ☐ Should be geared toward children not the community.

Theme Suggestions

- | | |
|---|--|
| ☐ Wild bird habitat | ☐ Mountain |
| ☐ Circus | ☐ Pioneer |
| ☐ <i>Native Alberta plants</i> | ☐ Change of Seasons |
| ☐ Castle | |

Name Suggestions

- | | |
|--|---|
| ☐ The School Garden Project | ☐ Nature's Joy |
| ☐ Elmwood Park | ☐ Summer All Year— |
| ☐ It's Green—It's Clean—It's
Elmwood | Neverending Summer |
| | ☐ Things of Summer |

Additional Suggestions

- | | |
|---|---|
| ☐ Lilac bushes | ☐ <i>Sundial</i> |
| ☐ <i>Roses</i> | ☐ Elm trees |
| ☐ Birch trees | ☐ Amphibian pond |
| ☐ Ferns | ☐ <i>Benches</i> |
| ☐ Drinking fountains | ☐ Flowering shrubs |
| ☐ Berry bushes | ☐ <i>Vegetable area—carrots,</i> |
| ☐ Grapevines | <i>peas, pumpkins</i> |
| ☐ Various perennials (heights,
blooming times). | ☐ Herbs |
| ☐ Study tables | ☐ Apple trees |
| | ☐ Tulips |

October 8, 2002

Dear Parents/Guardians:

Elmwood Elementary is one of eight schools in Edmonton to be selected to participate in a school-community naturalization project. This exciting project will offer students and community members "a more diverse and stimulating environment in which to play and learn."

Over the next ten months, a **school ground** greening committee will work toward the creation of an open garden to be used as an ecological learning environment. To find out more about this type of project go to: <http://www.evergreen.ca/en/index.html>.

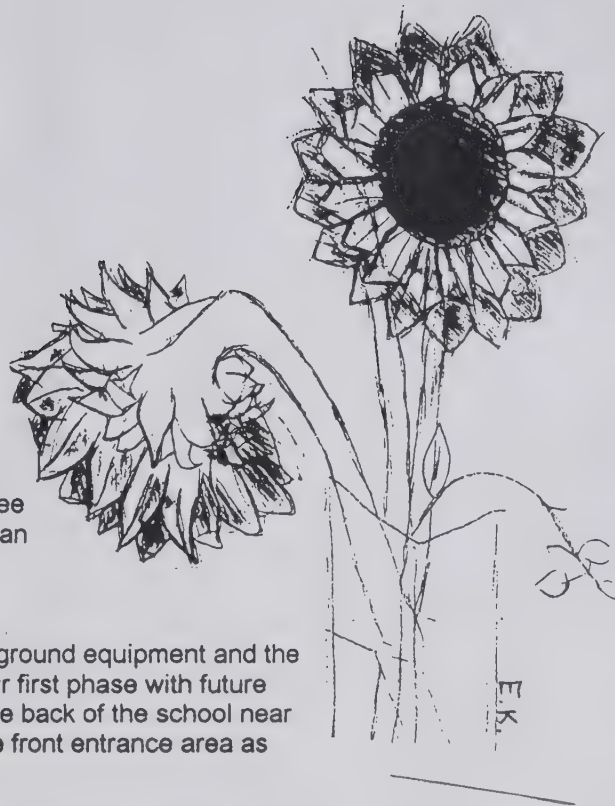
We are presently considering the area between the large playground equipment and the school for garden development possibilities. This would be our first phase with future plans of a glassed-in winter garden that would be located at the back of the school near the library entrance. We are also planning improvement of the front entrance area as well as the tarmac.

The Elmwood School community is being asked to help in the design of this space. Thank you for returning our first survey. We received an amazing total of 197! Unfortunately we were not as clear as we should have been and much of the feedback concerned our playground areas and equipment. Your comments have been forwarded to the appropriate parties. Below you will find the naturescape related suggestions compiled to date. Please discuss this list with your child(ren) and checkmark the seven features that you would most like to see in this space.

This survey data will be compiled and used at a design workshop for participating school committees on October 19. Results will follow thereafter.

Please complete, detach and return to your child's teacher by Friday, October 11.

Best regards,
Naturescape Team



Naturescape Project Priorities

*Trees, flowers and shrubs in a garden setting
was the most common suggestion.*

_____	Covered gazebos with seating	_____	Murals on walls
_____	Pond	_____	Pond with bridge
_____	Fish pond	_____	Tree house
_____	Decorative fountain/waterfall	_____	Fish pond with bridge
_____	Pathways	_____	Rocks to sit/climb on
_____	Garden swing	_____	Picnic tables
_____	Birdhouses/feeders	_____	Fruit trees
_____	Evergreen trees	_____	Sunflowers
_____	Wildflowers	_____	Dog path
_____	Shrubs	_____	Weather station

Should we have a theme? If so, please provide your suggestion.

Additional comments or suggestions?

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0 1620 1720 3157